

Abstracts of Technical Articles by Bell System Authors

*Weathering of Soft Vulcanized Rubber.*¹ JAMES CRABTREE and A. R. KEMP. Two separate and distinct processes are responsible for the breakdown of soft vulcanized rubber when exposed to outdoor weathering—light-energized oxidation and attack by atmospheric ozone. The former is independent of stress and controllable to any marked extent only by incorporation of opaquing fillers. The latter affects rubber only when under stress and is checked to a considerable degree by addition of certain hydrocarbon waxes as long as the stress is static. The conditions affecting these processes have been investigated, and suggestions for accelerated aging are made on the basis of the findings.

*A Note on a Simple Transmission Formula.*² HARALD T. FRIIS. A simple transmission formula for a radio circuit is derived. The utility of the formula is emphasized and its limitations are discussed.

*Applications of Thin Permalloy Tape in Wide-Band Telephone and Pulse Transformers.*³ A. G. GANZ. The properties and uses of thin permalloy tapes ranging from two mils to as little as 1/8 mil thick in tape cores are described. Typical applications covered are in transformers and non-linear coils for radar and for telephone systems. Data are given on the steady a-c. properties of thin tapes up to one megacycle. Pulse magnetization of the tape is analyzed. The available flux density range with uni-directional pulses and the effects of appropriate air gaps and of reverse magnetization between pulses are illustrated. Equations are given for flux distribution, effective permeability and loss, assuming linear magnetic properties, and convenient graphs for these characteristics are included. Simple expressions are developed for effective permeability and loss, which are approximations for the high d-c. permeability and rapid transition to saturation which characterize the permalloys.

*Derivation of the Lorentz Transformations.*⁴ HERBERT E. IVES. The Lorentz transformations were obtained by Lorentz as a succession of *ad hoc* inventions, to reconcile Maxwell's theory with the results of experiments on moving bodies. By Einstein they were derived after a discussion of the

¹ *Indus. & Engg. Chemistry*, March 1946.

² *Proc. I.R.E.*, May 1946.

³ *Elec. Engg., Trans. Sec.*, April 1946.

⁴ *Phil. Mag.*, June 1945.

nature of simultaneity, and the adoption of a *definition* of simultaneity which violates the intuitive and common-sense meaning of that term. It is the purpose of this paper to show that these transformations can be derived by imposing the laws of conservation of energy and of momentum on radiation processes as developed by Maxwell's methods.

*The Effect of High Humidity and Fungi on the Insulation Resistance of Plastics.*⁵ JOHN LEUTRITZ, JR. and DAVID B. HERRMANN. The decrease in insulation resistance of methyl methacrylate, glass bonded mica, glass mat laminate phenolic, phenol fabric, phenol fiber, and wood flour filled phenol plastic is determined during prolonged exposure of the plastics to fungi and 97 per cent relative humidity at 25 C. The same plastics with fungi present also are exposed to 87, 76, and 52 per cent relative humidity to study their recovery, and then re-exposed to 97 per cent relative humidity. Samples with cleaned surfaces and with varnished surfaces are dried and then exposed to fungi and high humidity. The insulation resistance of a fungus network on methyl methacrylate is determined at 87, 76, and 52 per cent relative humidity.

Fungus growth occurs on all the test specimens except those with cleaned or varnished surfaces. The decrease in insulation resistance is retarded by the varnish. The degradation is due entirely to moisture. The rate of recovery is dependent on the composition and structure of the materials. None of the plastics is permanently affected by exposure to fungi and high humidity. Cleaning of surfaces and removal of moisture restore the insulation resistance to its original high value in every case. Water adsorption and absorption, not fungi, are the critical factors in the deterioration of the insulation resistance of these plastics.

*The Elastic, Piezoelectric, and Dielectric Constants of Potassium Dihydrogen Phosphate and Ammonium Dihydrogen Phosphate.*⁶ W. P. MASON. Measurements have been made of all the elastic, piezoelectric, and dielectric constants of KDP and ADP crystals through temperature ranges down to the Curie temperatures. The piezoelectric properties agree well with Mueller's phenomenological theory of piezoelectricity provided the fundamental piezoelectric constant is taken as the ratio of the piezoelectric stress to that part of the polarization due to the hydrogen bonds. It is found that the dielectric properties of KDP agree well with the theory presented by Slater based on the interaction of the hydrogen bonds with the PO_4 ions. ADP undergoes a transition at -125°C which results in fracturing the crystal. This transition cannot be connected with the H_2PO_4 hydrogen bond system

⁵ *A.S.T.M. Bulletin*, January 1946.

⁶ *Phys. Rev.*, March 1 and 15, 1946.

which controls the dielectric and piezoelectric properties, for these lie on smooth curves that do not change slope as the transition temperature is approached. It is suggested that two separate and independent hydrogen bond systems are involved in ADP. The transition temperature and specific heat anomaly appear to be connected with hydrogen bonds between the nitrogens and the oxygens of the PO_4 ions, while the dielectric and piezoelectric properties are controlled by the H_2PO_4 hydrogen bonds.

*Nonlinearity in Frequency-Modulation Radio Systems due to Multipath Propagation.*⁷ S. T. MEYERS. A theoretical study is made to determine the effects of multipath propagation on over-all transmission characteristics in frequency-modulation radio circuits. The analysis covers a simplified case where the transmitted carrier is frequency-modulated by a single modulating frequency and is propagated over two paths having relative delay and amplitude differences. Equations are derived for the receiver output in terms of the transmitter input for fundamental and harmonics of the modulating frequency. Curves are plotted and discussed for various values of relative carrier- and signal-frequency phase shift and relative amplitude difference of the received waves.

The results show that a special kind of amplitude nonlinearity is produced in the input-output characteristics of an over-all frequency-modulation radio system. Under certain conditions, sudden changes in output-signal amplitude accompany the passage of the input-signal amplitude through certain critical values. Transmission irregularities of this type are proposed as a possible explanation of so-called "volume bursts" sometimes encountered in frequency-modulation radio circuits. In general, it appears that amplitude and frequency distortion are most severe where the relative delay between paths is large and the amplitude difference is small.

*Propagation of 6-Millimeter Waves.*⁸ G. E. MUELLER. One step in the exploration of a new band of frequencies for communications purposes is a study of the transmission properties of the medium involved. This paper describes the methods and results of measurements of attenuation due to rainfall and atmospheric gases at a wavelength of 0.62 centimeter.

The one-way attenuation due to moderate rains at 0.62 centimeter is roughly 0.6 decibel-per-mile per millimeter-per-hour. The gas attenuation is probably less than 0.2 decibel per mile.

*Vicalloy—A Workable Alloy for Permanent Magnets.*⁹ E. A. NESBITT. Alloys in the region of 30 to 52 per cent iron, 36 to 62 per cent cobalt, and 4

⁷ *Proc. I.R.E.*, May 1946.

⁸ *Proc. I.R.E.*, April 1946.

⁹ *Metals Technology*, February 1946.

to 16 per cent vanadium were investigated with the result that permanent magnet materials of unusual mechanical as well as magnetic properties were discovered. The alloys differ from most age-hardening alloys in that the gamma phase, stable at high temperatures, is dispersed in the alpha phase, stable at low temperatures, instead of vice versa.

*Distribution of Sample Arrangements for Runs Up and Down.*¹⁰ P. S. OLMSTEAD. Using the notation of Levene and Wolfowitz, a new recursion formula is used to give the exact distribution of arrangements of n numbers, no two alike, with runs up or down of length p or more. These are tabled for n and p through $n = 14$. An exact solution is given for $p > n/2$. The average and variance determined by Levene and Wolfowitz are presented in a simplified form. The fraction of arrangements of n numbers with runs of length p or more are presented for the exact distributions, for the limiting Poisson Exponential, and for an extrapolation from the exact distributions. Agreement among the tables is discussed.

*Radar Systems Considerations.*¹¹ D. A. QUARLES. In the broad field of radio technology, radar (object location) systems have come to occupy a relatively new but highly specialized area. Because radar is a seeing and measuring art, it has put a special premium on short wavelength and has thus tended to accelerate greatly the already rapid trend toward higher frequencies. Moreover, many radar systems are associated with computer and servo mechanisms for automatic control purpose such as gunfire, bomb release and the like. To meet these new needs, a dozen or more highly developed fields of specialization covering such components as antennas, pulse transmitters and display devices have been created. Planning a new radar system calls for an appraisal of these component arts and for selection and balancing of component characteristics to produce an integrated system. The present paper deals with such technical considerations involved in planning an overall radar system as a background for other more detailed technical expositions of the component arts.

*The Effect of Rain upon the Propagation of Waves in the 1- and 3-Centimeter Regions.*¹² SLOAN D. ROBERTSON and ARCHIE P. KING. This paper presents some experimental results which show the effect of rain upon the transmission of electromagnetic waves in the region between 1 and 4 centimeters.

At a wavelength of 1.09 centimeters, the waves are appreciably attenuated,

¹⁰ *Annals of Mathematical Statistics*, March 1946.

¹¹ *Elec. Engg., Trans. Sec.*, April 1946.

¹² *Proc. I.R.E.*, April 1946.

even by a moderate rain. Attenuations in excess of 25 decibels per mile have been observed in rain of cloudburst proportions.

The attenuation of waves somewhat longer than 3 centimeters is slight for moderate and light rainfall. During a cloudburst, however, the attenuation may approach a value of 5 decibels per mile.

*The Advancing Statistical Front.*¹³ W. A. SHEWHART. From the viewpoint of general education, statistics is not simply a tool as is so often stated, but a scientific way of looking at the universe; statistical method is not something apart from scientific method but *is* scientific method in which the three steps, hypothesis, experiment, and test of hypothesis, are adjusted to allow for the fact that scientific inference is only probable. Applications of statistics in this sense are rapidly extending to all fields of pure, background, and applied research.

*A New Crystal Channel Filter for Broad Band Carrier Systems.*¹⁴ E. S. WILLIS. A new crystal channel filter for use in broad-band carrier telephone systems is described. It requires less than two-thirds as much mounting space as the earlier design and savings in materials and manufacturing effort are realized. The savings were made possible by assembling the four crystal units in one lattice-type filter section rather than two, resulting in a reduction in the number of component coils and capacitors.

¹³ *Jour. Amer. Statis. Assoc.*, March 1946.

¹⁴ *Elec. Engg., Trans. Sec.*, March 1946.